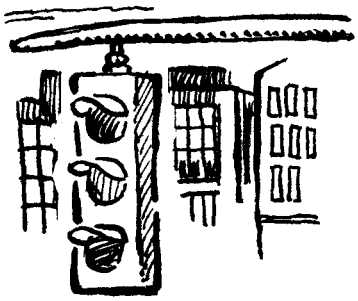
Light-Emitting Diodes



EPA's State and Local Climate Change Program helps build awareness, expertise, and capacity to address the risk of climate change at the state and local levels. The program provides guidance and technical information to help state and local agencies prepare inventories of greenhouse gas emissions, develop action plans to reduce emissions, and educate their constituents. By emphasizing the many economic and environmental benefits of greenhouse gas reductions, the program encourages state and local decisionmakers to implement voluntary measures to reduce their greenhouse gas emissions.

LED Traffic Signals and Exit Signs

Traffic signals, pedestrian signals, and exit signs consume significant amounts of energy. U.S. buildings have more than 100 million exit signs, which cost $1 billion annually to operate. An estimated 3 to 4.5 million traffic signals are operating on the nation's streets at a cost of approximately $2 billion annually. Municipalities can reduce energy costs, air pollution, and greenhouse gas emissions by replacing conventional incandescent fixtures with light-emitting diode (LED) traffic and pedestrian signals and exit signs.

LEDs are semiconductor chips that convert electrical energy directly into light. They do not have "bulbs" like conventional lighting technologies, but they do use a lens to concentrate and direct the light. LEDs use much less power and last much longer than incandescent lights. They are efficient, give off little heat, and can be embedded in plastic and other durable materials.

Early versions of LED technology had very low light output and were used primarily for indicator lights on electronic equipment. During the 1990s, however, industry developed brighter LEDs that are suitable for use in traffic and railroad signals, exit signs, and automobile turn and brake signals. For such applications, LEDs are bundled together to provide adequate illumination.

Replacing a red incandescent traffic signal head with a red LED unit will cut energy use by an estimated 82 to 93 percent. The payback for the initial investment in red LED traffic lights is approximately 2.5 to 3 years through energy savings. The actual payback period depends on energy prices, the cost of the units, and any financial incentives offered by utilities or government agencies.

LED traffic signals are estimated to last 5-10 years before they must be replaced, compared with 1 to 2 years for incandescents. Maintenance costs thus are expected to be lower with LEDs. The longer life and greater reliability of LEDs also may help reduce the risk of lawsuits against municipalities for accidents caused by burned-out traffic signals.

Red traffic signals and pedestrian "Don't Walk" signals are the most cost-effective candidates for replacement with LEDs. Red LEDs cost less to manufacture than green or amber LEDs and they are more luminous, requiring fewer individual LEDs per signal. However, electricity rate structures in some locations may make green LED traffic signals cost-effective, and a number of states and cities have begun to install them at intersections. Green LEDs also may be used for pedestrians' crossing signals.

LEDs also work well for exit signs: LEDs are more efficient and more visible in emergency egress situations than standard incandescent signs. A standard 40-watt incandescent exit sign can be replaced with a 5-watt LED sign. A 1999 survey by the Lighting Research Center at Rensselaer Polytechnic Institute found

BENEFITS OF LEDs

- Greatly reduced energy costs.
- Longer lifetime than incandescent lights.
- Lower maintenance costs.
- Reduced air pollution.
- Fewer emissions of greenhouse gases.
- Reduced liability exposure.

that about 80 percent of the exit signs sold in the United States in 1998 used LEDs as the primary light source. Retrofit kits for converting existing exit signs to LEDs are now available on the market, and installation may take as little as 15 minutes.

Blue, amber, and phosphor-coated "white" LEDs are becoming available and may be used increasingly in the future for a wide range of signal and sign applications, including roadway sign lighting. LEDs also are being used for directional path markers along pavements and walkways. LED "light bulbs" (screw-mounted lamps in the shape of incandescent bulbs) are available for beacon and accent lighting, and for a wide variety of retail lighting applications.

The economic and environmental savings of LED traffic signals can be substantial. In Colorado, the City and County of Denver began upgrading traffic signals to LEDs in 1996. All of the area's 17,036 red traffic signals and "Don't Walk" signals have been converted. Energy costs have dropped by approximately $20,000 per month, and the city estimates annual savings of $128,000 in material and labor costs. The net savings over the lifetime of the LED units is expected to exceed $5.1 million. The project will avoid an estimated 8,894 tons of greenhouse gas emissions annually, as well as 6.4 tons of sulfur dioxide and 6.7 tons of nitrogen oxides. Denver is preparing to convert all of its green traffic signals to LEDs and anticipates savings comparable to those from installing the red units.

Potential barriers to LED traffic signals include their initial cost, lack of information about LEDs, and uncertainty about performance and reliability. LEDs also are temperature-sensitive, and special measures must be taken for installation in high-temperature climates.

The Federal Role

Currently no federal programs specifically promote LED traffic signals, although the joint U.S. Environmental Protection Agency and U.S. Department of Energy ENERGY STAR® program is contemplating an ENERGY STAR traffic signal program.

The EPA/DOE voluntary ENERGY STAR Exit Signs Program encourages manufacturers to produce energy-efficient exit signs and helps consumers become aware of them. Participating manufacturers' products that meet the program's voluntary performance guidelines can carry the ENERGY STAR label to demonstrate to consumers that these products are energy efficient.

ENERGY STAR exit signs use five watts or less of electricity per face, with or without an emergency battery. By purchasing 1,000 ENERGY STAR-compliant exit signs for an initial investment of $30,000, a state government could save a net $455,562 over the products' lifetime. The new signs would pay for themselves in six months and would reduce carbon emissions by 125,049 pounds per year, equivalent to removing 46 cars from the road annually. Over the signs' lifetime, they would reduce carbon emissions by 625 tons.

In addition to its support of LEDs through the ENERGY STAR program, EPA continues to fund LED research at the Lighting Research Center.

State Experience with LEDs

A growing number of municipalities and some state governments are using LEDs in traffic signals and retrofitting existing exit signs with LEDs. Pioneers in this technology include Denver, Philadelphia, and a number of cities in California. Minnesota has written ENERGY STAR specifications for exit signs into its state energy code.

Pennsylvania

In April 1997, the City of Philadelphia began a two-year, $3 million replacement of approximately 28,000 signal heads with LEDs at all city intersections. The city began experimenting with LED traffic signals in 1993, starting with signals at 27 intersections.

In fiscal year 1998, the citywide relamping project saved $270,000 in energy costs, with projected savings of $750,000 in FY 99. During FY 2000—the first full year of citywide LED signal operations—the estimated annual energy savings will be $887,000, plus additional savings of $165,000 from lower maintenance costs. Philadelphia estimates that the project will avoid almost 7,000 tons of carbon dioxide (CO_2) emissions annually, as well as 80 tons of sulfur dioxide (SO_2) and 25 tons of nitrogen oxides (NO_X).

For its LED project and other energy-saving efforts, Philadelphia received a Special Recognition Award in 1996 from DOE and was selected as Green Lights Partner of the Year in 1997 by EPA.

California

Approximately 30 California municipalities have installed LED traffic signals. Recently, the California Department of Transportation (Caltrans) followed suit and plans to install up to 72,000 LED traffic signal fixtures in 1999 and 2000. This project will save the State of California and local governments an estimated 47.3 million kilowatt-hours of electricity. The energy savings will be used to underwrite the costs of purchasing and installing the new fixtures. By early June 1999, Caltrans had installed 14,000 of the planned 72,000 LED fixtures.

Caltrans is working with the California Department of General Services to establish a Master Service Agreement (MSA) that would allow California's state and local governments to buy from a contract that limits vendors to products that meet Caltrans standards. The MSA also will set up a base price for LED fixtures within California.

For More Information

Information on ENERGY STAR-labeled exit signs and other products is available from the ENERGY STAR program.

Website: *http://www.energystar.gov*

The *Lighting Research Center* at Rensselaer Polytechnic Institute has information on LEDs in transportation applications and exit signs.

Website: *http://www.lrc.rpi.edu/Ltgtrans/led/index.html*

The *Institute of Traffic Engineers* sets standards for traffic lights and has developed an interim standard for LED traffic lights.

Website: *http://www.ite.org/*

The *California Department of Transportation* (Caltrans) has developed specifications on LED traffic signals.

Website: *http://www.dot.ca.gov/hq/traffops/elecsys/led/*

EPA's *State and Local Climate Change Program* helps states and communities reduce emissions of greenhouse gases in a cost-effective manner while they address other environmental problems.

Website: *http://www.epa.gov/globalwarming/ and click on "Public Decision Makers" under the "Visitors Center."*